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Evaluation role of some types of plant fertilizers toward leaf miners insect and its parasitoid on broad bean Vicia faba (L.)

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Abstract

The role of four fertilizers type namely (biofertilizers, organic manure, compost el Wadi and chemical fertilizer) toward the population fluctuation of leafminers, Liriomyza spp. and its damage to snap faba bean were evaluated. The population fluctuation of leafminer Liriomyza spp and its' parasitoid increased in case of fertile soil more than unfertile one. The relation between the population fluctuation of leafminer parasitoid was positively affected by the population of leafminers. On other side, the results indicated that the growth parameters of fertile plant were recorded significant variation more than unfertile plant.

Keyword: Fertilizer; faba bean; leaf miner; parasitoid; damage; plant growth.

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Introduction

Insects are the major source of crop damage, yield and quality reduction in agriculture area around the world, especially in Egypt.

Many researchers have suggested that many insect pests pressure in agro ecosystems due to change in agricultural practices since the World War II. For example, the usage of chemical fertilizers and pesticides has increased rapidly during this period and evidence suggests that such excessive use of agrochemicals in conjunction with expanding monocultures has exacerbated pest problems (Conway and Pretty, 1991)[1].

Overcome insect pest problem and avoidance or minimize the pesticide usage must be created the conditions to grow healthy plants which able to resist or tolerant toward pests attack. Reduced susceptibility to pests may be a reflection of differences in plant health, as mediated by soil fertility management (Phelan et al., 1995)[2]. Many researchers and also practicing farmers have observed that fertility practices that replenish and maintain high soil organic matter and that enhance the level and diversity of soil macrob and microbiota provide an environment that through various processes enhances plant health (McGuiness,1993)[3].

The broad bean Vicia faba (L.) exposed to different pests and diseases at different times of their growth cycle. There are more than five species of leaf miners attach broad bean. The leaf miners Liriomyza spp. is considered the most famous pests that attack leaves and caused stunted growth and reduced yield, and are difficult to control as they protected from any direct treatment by feeding within the inner tissues of leaves. In most seasons, the populations of L. spp are effectively controlled by its parasites. Several parasitoids are mentioned as present in faba bean fields at Damnhour, Sids and El-Zarka in Egypt on L. cicerina, Liriomyza bryoniaeand Liriomyza sativae: Dacnusa isaea; Hemiptarsenus zilahisebessi; Chrysonotomyia sp.; Pnigalio sp.; Opius sp.; and Cirrospilus sp. (El-Serwy, 2003)[4].

The present studies aimed to compare the efficacy of different types of plant fertilizer toward population Liromyza spp and its' parasitoid on faba bean.

Materials and Methods

A field experiment was conducted during the successive growing season of 2013 – 2014 seasons at El-Mahmodah village, Dekernes district, Ad-Daqahliah governorate, Egypt. The experimental area was divided into plots of 1/100 feddan (feddan equal 4200 m^2) each arranged in randomized blocks design with three replicates for each treatment. The faba bean variety Giza 843 was cultivated at 19 November 2013. The normal agricultural practices were achieved. Four types of fertilizers (Chemical fertilizer, Biofertilizers, Organic manure and Compost Elwadi) were evaluated (Table 1). Infestation of faba snap bean leaflets with leaf miner was recorded after one month from plantation. The leaflets were collected in paper sacs weekly for three months to examine under steriomecroscopy in Lab. From weekly investigation was calculated the population fluctuation of Liriomyza spp. and its parasitoids and its' correlation. The percentage of leafminer infestation was calculated as follows:

$$\text{Damage \%} = \frac{\text{Number of mine in leaflets}}{\text{Total number of examined leaflet}} \times 100$$

During fruiting season (nearly, four month after plantation was calculated the height and number of green faba pods in shot. After harvested bean was collected the dry seeds and weight to calculate the yield / feddan.

Results

1. Population fluctuation of leaf miners:

The results in Table 1 indicated that the population fluctuation of Liriomyza spp relatively affected by the soil fertilizer, especially in case of fertilization by organic manure and biofertilizers comparable with unfertile and chemical fertilizer (Table2). The population fluctuation of leaf miners increased significantly ($P \leq 0.05$) on faba bean leaflet resulted from soil fertilized by biofertilizers and organic manure, reaching to 31.91±2.76 and 29.59±3.72 larva inside mine /20 leaflets, compare to unfertile faba bean leaflet was 20.56±2.22 larva inside mine /20 leaflets.

On other side, during investigation was noticed that there are fluctuation in the percentage of leaf miners infestation to faba bean leaflets along its growth period, as shown in Fig1. During February month, the highest percentage of leaf damage was recorded on leaflets of faba bean which fertilized with chemical fertilizers and compost. While March month was recorded the biggest damage peck in case of fertilization by biofertilizers, organic manure and compost compare to unfertilized plant.

2. Population fluctuation of leaf miner's parasitoid:

There was positive correlation between the population fluctuations of leaf miner's parasitoids and the population of liriomtza spp on different fertilize of faba bean leaves as cleared in Table 3. The highest significant variation ($P \leq 0.01$) was recorded inside leaf tunnels which was observed on faba bean leaflets fertilized by biofertilizers, was being 6.72±1.19 immature stage of leaf miners parasitoid/20 leaflets, followed by 4.99±1.16 immature stage of leaf miners parasitoid/20

leaflets in case of fertilize by organic manure, compared to 3.5±0.60 immature stage of leaf miners parasitoid/20 leaflets in unfertilized one.

3. Relation between leaf miners damage and some physical properties and yield of faba bean plants:

The height, number of pods and yield of faba bean plant due to usage different soil fertilizers described in table 4. All tested fertilizers was recorded highly significant (P≤0.01) variation in height, number of pods and yield of faba bean plant, except in case of the biofertilizer which wasn't recorded variation (P>0.05) in yield of faba bean compare to unfertilized plant. The highest yield was recorded in case of fertilized by NPK follow by compost and organic fertilizer were 1583 ± 8.81, 1457.0 ± 8.81 and 1393.0 ± 12.0 weight / feddan, respectively compare to the production of unfertile plant was 1287.0 ± 8.81 weight / feddan.

Discussion

From the obtained results were recorded that the population fluctuation of leafminers, *Liriomyza* spp. and its damage to snap faba bean affected by type of fertilizer. The population fluctuation of leafminer insects and its parasitoid increased in case of fertile soil more than unfertile one. On other side, the results indicated that the growth parameters of fertile plant were recorded significant variation more than unfertile plant. *Liriomyza* spp. was positively affected by amendments application.

Fertilizers are sources of plant nutrients that can be added to soil to supply its natural fertility. They are intended to supply plant needs directly rather than indirectly through modification of such properties such as soil pH and structure. There is usually a dramatic improvement in both quantity and quality of plant growth when appropriate fertilizers are added (Nahed, 2007)[5].

These results corroborated the hypotheses that insects respond to fertilizer treatment (Luna, 1988)[6], and that for annual crops, insect damage, colonization rates, growth rates, fecundity and population sizes are usually higher on plants supplied with adequate nutrients (Jansson *et al*., 1991; Jansson and Ekbom, 2002)[7&8].

The high level of natural enemies on fertile plots compared to the conventional fertilizer treatment or unfertile plant has also been observed in many other studies (Drinkwater et al., 1995; Letourneau and Goldstein, 2001)[9&10]. This could be explained by the corresponding high levels of *Liriomyza* spp infestation which had a highly significant positive Pearson's two-tailed correlation. Other studies have also found high levels of natural enemy occurrence on plants receiving composts as compared to others (Eigenbrode & Pimentel, 1988, Kalule, 2002 and Karungi *et al*., 2006)[11-13].

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Table1: The common name, Dosage and source of tested fertilizers.

Common name of tested fertilizer	Dosage /Feddan	Source
Microbien (Bio-fertilizer)	A mixture of four microbial species in equal portions (Bacillus megatherium, Azotobacter sp., Azospirillium sp. and Pseudomonus sp.) it mixed with seeds before cultivated (half hour).	General Organization of Agric. Fund, Ministry of Agric. Egypt
Organic fertilizer	Cattle dung. The rate of use is 20 m^3 / fed.	Ad-Daqahliah farm, Egypt
Compost Elwadi	The rate of use 5 Ton / fed	Delta Bio- Tec, Egypt.
Chemical fertilizer (NPK)	The rate of use 100, 150 and 48 kg / fed. of mineral nitrogen, potassium and phosphorus fertilizers, respectively.	Abu qeer company Egypt

Table (2): Effect of four types of plant fertilizers on the population fluctuation of *Liriomyza* spp on leaf of broad bean.

Date / Treatments		Number of leaf miners tunnels / 20 leaflets				
		Without fertilizer	Bio-fertilizer	Organic manure	Compost	Chemical fertilizer
Jan.	5	13.3	17.0	16.7	13.3	13.0
	12	14.3	31.7	18.0	21.3	27.7
	19	13.3	26.3	27.7	23.3	15.3
	26	19.3	30.7	19.0	21.3	27.7
Mean		15.1	26.5	20.3	19.8	20.9
Feb.	2	16.7	36.0	19.3	8.3	26.0
	9	16.0	39.0	37.7	12.3	23.3
	16	22.3	41.0	50.3	37.0	35.7
	23	34.7	40.3	52.3	37.7	45.7
Mean		22.4	39.1	39.9	23.8	32.7
Mar.	2	28.7	43.7	41.3	44.3	32.7
	9	33.3	46.3	49.7	48.3	39.3
	16	26.3	30.0	27.7	31.7	24.7
	23	28.0	32.7	24.0	27.3	20.3
	30	12.3	21.3	17.3	10.7	13.3
Mean		25.7	34.8	32.0	32.5	26.0
Apr.	6	9.3	10.7	13.3	11.3	8.7
General mean		20.56±2.22 [a]	31.91±2.76 [c]	29.59±3.72 [b]	24.86±3.53 [a]	25.24±2.86 [a]
Statistical analysis		L.S.D.$_{0.05}$=7.2509703		L.S.D.$_{0.01}$=10.371		

The means with the same letter had no significant different P>0.05.

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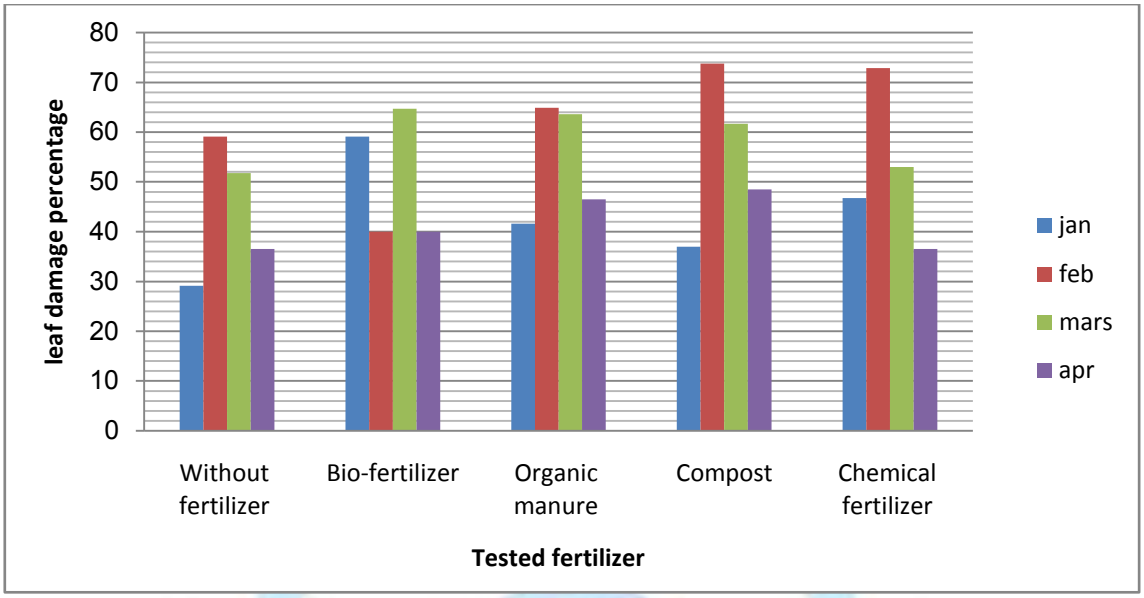

Fig (1): Impact of tested fertilizers on the percentage of leaf infestation by Liriomyza spp.

Table (3): Effect of four types of plant fertilizers on the population fluctuation of leaf miner parasitoid.

Treatments / Date		Number of immature stage of leaf miners parasitoid/20 leaflets				
		Without fertilizer	Bio-fertilizer	Organic manure	Compost	Chemical fertilizer
Jan.	5	0.0	0.0	0.0	0.3	0.3
	12	1.3	0.33	1.0	1.3	1.3
	19	1.7	5.3	2.0	2.7	4.0
	26	3.0	5.7	3.7	4.7	4.7
Mean		1.5	2.83	1.67	2.25	2.57
Feb.	2	3.7	9.3	2.0	2.3	6.7
	9	5.0	10.3	3.7	3.7	6.7
	16	6.3	11.3	8.3	4.3	8.0
	23	6.3	14.0	15.3	5.3	10.3
Mean		5.3	11.2	7.33	3.9	7.9
Mar.	2	7.3	11.3	10.0	10.0	9.7
	9	5.0	9.3	9.3	6.0	7.0
	16	3.7	7.3	6.0	2.3	5.0
	23	2.7	6.3	4.3	2.0	3.3
	30	2.3	2.7	3.3	1.0	1.0
Mean		4.2	7.4	6.6	4.3	5.2
Apr.	6	0.7	1.0	1.0	0.3	0.0
General mean		3.5±0.60[a]	6.72±1.19 [c]	4.99±1.16 [a]	3.3±0.71 [a]	4.86±0.91[a]
Statistical analysis		L.S.D.$_{0.05}$=2.2 L.S.D.$_{0.01}$=3.2				
correlation with population of leaf miners =+ 0.86						

The means with the same letter had no significant different P<0.05.

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Table 4: Effect of fertilizer sources on number of pods / plant, plant length (cm) and yield

Fertilizer type	Length cm / plant (mean ±S.E)	No. of pods / plant (mean ±S.E)	Yield kg / feddan (mean ±S.E)
Without fertilizer	96.67 ± 1.33[a]	6.67 ± 0.333[a]	1287.0 ± 8.81[a]
Biofertilizers	101.67 ± 1.86[d]	7.33 ± 0.333[b]	1297.0 ± 8.81[a]
Organic fertilizer	102 ± 1.15[d]	8.33 ± 0.333[c]	1393.0 ± 12.0[d]
Compost	103.67 ± 0.333[d]	9.0 ± 0.58[c]	1457.0 ± 8.81[d]
Chemical fertilizer	106.33 ± 0.66[d]	9.67 ± 0.66[c]	1583 ± 8.81[d]
LSD 5 %	3.06	1.21	24.46

The means with the same letter had no significant different P>0.05.